Summary of the Invention

Broadly, the present invention concerns new classes of heterocyclic aromatic cationic compounds, and in particular new classes of phenanthridinium derivatives, most notably dihydro-imidazo-phenanthridinium (DIP) compounds. These findings are based on the reaction of the middle b ring of a phenanthridinium core with primary amines to form DIP compounds (Formula A) or secondary amines to form 2-aminoalkyl phenanthridinium derivatives (Formula B). These reactions can also be applied to other classes of starting compounds which comprise a 6-membered ring aromatic heterocycle having a ring nitrogen and at least one alpha hydrogen atom which can be reacted with a primary or secondary amine.

Moreover, analogous reactions can be carried to produce dihydro-thiazoles, e.g. by reaction with a ~~sulphate~~ sulphide such as sodium ~~sulphate~~ sulphide Na_2S, and to produce dihydro-oxazoles, e.g. by reaction with a hydroxide such as KOH.

Typically, the chemistry disclosed herein has the advantage that is amenable to scaling up to large scale production as it does not involve any particularly hazardous reaction procedures. Further, the one pot reactions disclosed herein are usually carried out at room temperature and usually take less than 12 hours, with the result that the energetic cost of the industrialization process may be quite low.

In general, N-based heteroaromatic cations are highly interesting compounds due to their reactivity and biological properties. For instance, molecules containing a phenanthridinium core are one important subset of heteroaromatic cations with applications as drugs

(topoisomerase inhibitors and DNA targeting agents), dyes and probes due to their high affinity for DNA. Moreover, a simple purification method (i.e. filtration of the reaction medium and wash) may make them very good candidates for combinatorial chemistry. Finally, because of the highly effective hydride transfer of the intermediaries in forming the phenanthridinium derivatives, there may be applications in non-enzymatic redox transformation, e.g. the reduction of ketones, sulfonatates, arenediazoniums and aldehydes.

A first class of compounds represented herein by Formula A are based on the ring extension of the heteroaromatic middle **b** ring of the phenanthridinium core, typically forming a new 5-8 membered ring, and more preferably a five or six membered ring. The new ring may comprise a dihydro-imidazolium, a dihydro-thiazolium, a dihydro-oxazolium moiety or a tetrahydro-pyrimidinium moiety, depending on whether the reaction is carried out with a primary amines or a ~~sulphate~~ sulphide or hydroxide compound to introduce a nitrogen, a sulphur or an oxygen heteroatom respectively. A second class of compounds represented by Formula B are based on the reaction of the heteroaromatic middle b ring of the phenanthridinium core with secondary amines, followed by an intramolecular rearrangement process.

In other aspects, the present invention provides methods for synthesising the compounds of the invention. The inventors have also elucidated the mechanisms of these reactions which are unprecedented. The mechanisms provide a basis for extending the specific reaction described herein to the synthesis of other types of heterocyclic aromatic cationic compounds.

preferably, the pH of the reaction is less that about 10, and more preferably is less than about 9.

For primary amines, this second method B is much more advantageous than the first one. Nevertheless, the first Method A is generally preferred for the formation of dimers, trimers and multimers because, for solubility reasons, DMF is more appropriate. Method A is also better for the formation of [5-(2-amino-alkyl)-phenanthridiniums *via* the use of secondary amines.

Accordingly, the synthetic methods disclosed herein provide a strategy for the synthesis of the compounds of the invention. In the syntheses illustrated herein, the reaction of a primary amine is used to produce derivatives of [2,3-dihydro-1*H*-imidazo [1,2-*f*] phenanthridin-4-ylium bromide] or the reaction of a secondary amine is used to produce derivatives of [5-(2-amino-ethyl)-phenanthridinium. However, the reactions disclosed herein are general and can be extended to other heterocyclic aromatic moieties containing a ring nitrogen and at least one adjacent alpha hydrogen. Furthermore, the reactions are extremely easy to perform as isolating a pure final product simply requires a filtration and a washing procedure to afford product in high yield.

Accordingly, in a further aspect, the present invention provides a method of synthesising a heterocyclic aromatic cationic compound with an additional ring, the method comprising reacting a heterocyclic aromatic cationic compound comprising a ring nitrogen and at least one alpha hydrogen atom with a substituted or unsubstituted primary amine, a ~~sulphate~~ sulphide or a hydroxide, wherein the primary amine, ~~sulphate~~ sulphide or hydroxide reacts with the heterocylic

aromatic compound by alpha addition, cyclisation and an oxidation step thereby providing the heterocyclic aromatic compound with an additional ring. In preferred embodiments, the ring produced in this reaction is five membered. In a preferred embodiment, the heterocyclic aromatic starting material is the 2-bromo-ethyl-phenanthridinium, which reacts with a primary amine to yield a 2,3-Dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide derivative.

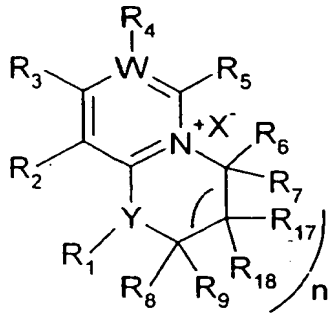
The method can be used for the production of 5 and 6-membered rings and to produce thiazole and oxazoles as well as phenanthridinium compounds by using a ~~sulphate~~ sulphide or a hydroxide respectively. The Methods A and B described herein are particularly advantageous as they involve an addition and a cyclisation followed by an aromatisation process that involves one equivalent of the starting material as an oxidizing agent (Method A) or a external oxidizing agent like NBS (Method B). In preferred embodiments, this has the particular advantage that the reaction can proceed in one pot. While the application of this new chemistry to the production of phenanthridinium compounds in which the b ring is extended is preferred, the reaction is equally applicable to the extension of other heteroaromatic compounds such as quinolines, isoquinolines, quinazolines or pyridines.

In one embodiment, the method is for making a compound represented by Formula A and comprises:

reacting a heterocyclic aromatic compound represented by the Formula A':

Claims:

1. A compound represented by Formula A:



wherein:

n = 0, 1, 2 or 3 such that:

when n = 0, the substituents R_{17} and R_{18} and the carbon atom to which they are bonded are not present; and

when n is 1, 2 or 3, the substituents R_{17} and R_{18} present on the respective carbon atom(s) may be the same or different and are independently selected from hydrogen or a substituent;

W is C or N, such that when W is N, R_4 is a lone pair of electrons;

Y is selected from N, O or S, such that:

when Y is O or S, R_1 is a lone pair of electrons; or

when Y is N, R_1 is selected from hydrogen, unsubstituted or substituted C_{1-7}alkyl, unsubstituted or substituted C_{1-7}cycloalkyl, unsubstituted or substituted C_{1-7}cycloalkyl-C_{1-7}alkyl, unsubstituted or substituted C_{5-20}aryl, unsubstituted or substituted C_{5-20}aryl-C_{1-7}alkyl, unsubstituted or substituted C_{3-20}heterocyclyl, or a linking group to form a multimeric compound in which a plurality of compounds represented by Formula A are covalently bonded together;

independently R_2 and R_3 and/or R_4 and R_5 together ~~can~~ form an aromatic carbon or heterocyclic ring structure,

optionally substituted with one or more aromatic substituents, or R_2, R_3, R_4 and R_5 are independently selected from an aromatic substituent;

R_6 and R_7 are independently selected from hydrogen or independently or together can be a substituent;

R_8 and R_9 are independently selected from hydrogen or independently or together can be a substituent;

wherein when R_{17} and R_{18} are present, they are independently selected from hydrogen or independently or together can be a substituent; and

one of the substituents R_6 and R_7 which is present on the carbon atom at the alpha position to the aromatic ring may form a double bond with one of the substituents R_8 and R_9 or R_{17} and R_{18} which is present on the carbon atom at the beta position to the aromatic ring; and

X^- is an anionic moiety;

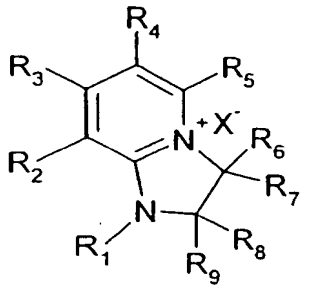
and wherein:

the substituent or substituents are independently selected from halo, hydroxy, oxo, ether, formyl, C_{1-7}alkylacyl, C_{5-20}arylacyl, acylhalide, carboxy, ester, acyloxy, amido, acylamido, thioamido, tetrazolyl, amino, nitro, nitroso, azido, cyano, isocyano, cyanato, isocyanato, thiocyano, isothiocyano, sulfhydryl, thioether, sulfonic acid, sulfonate, sulfone, sulfonyloxy, sulfinyloxy, sulfamino, sulfonamino, sulfinamino, sulfamyl, sulfonamido, C_{1-7}alkyl, C_{1-7}haloalkyl, C_{1-7}hydroxyalkyl, C_{1-7}carboxyalkyl, C_{1-7}aminoalkyl, C_{5-20}aryl-C_{1-7}alkyl, C_{3-20}heterocyclyl, or

C_{5-20}aryl; and

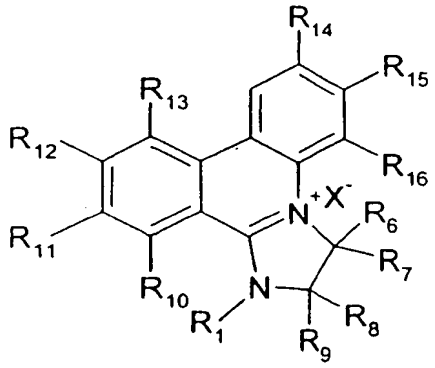
the aromatic substituent or substituents are independently selected from hydrogen, -F, -Cl, -Br, -I, -OH, -OMe, -OEt, -SH, -SMe, -SEt, -C(=O)Me, -C(=O)OH, -C(=O)OMe, $-CONH_2$, -CONHMe, $-NH_2$, $-NMe_2$, $-NEt_2$, $-N(nPr)_2$, $-N(iPr)_2$, -CN, $-NO_2$, -Me, -Et, $-CF_3$, $-OCF_3$, $-CH_2OH$, $-CH_2CH_2OH$, $-CH_2NH_2$, $-CH_2CH_2NH_2$, -Ph, ether, ester, amido, amino, C_{1-7}alkyl, C_{1-7}haloalkyl, C_{1-7}hydroxyalkyl, C_{1-7}carboxyalkyl, C_{1-7}aminoalkyl, or C_{5-20}aryl-C_{1-7}alkyl.

2. The compound according to claim 1, wherein the compound is represented by Formula Ai:



wherein the substituents are as defined in claim 1.

3. The compound according to claim 1 or claim 2, wherein the compound represented by Formula Aii:



wherein the R_1, R_6, R_7, R_8 and R_9 substituents are as defined in claim 1 and R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, R_{15} and R_{16} substituents are independently selected an aromatic substituent.

4. The compound according to any one of the preceding claims, wherein R_1 is a substituted C_{1-7}alkyl group selected from substituted C_{1-7}alkyl, C_{1-7}haloalkyl, C_{1-7}hydroxyalkyl, C_{1-7}carboxyalkyl, or C_{1-7}aminoalkyl.

5. The compound according to any one of the preceding claims, wherein R_1 is a selected from C_{5-20}aryl, C_{5-20}carboaryl, C_{5-20}heteroaryl, C_{1-7}alkyl-C_{5-20}aryl or C_{5-20}haloaryl, optionally substituted with one or more substituents.

6. The compounds according to any one of the preceding claims which is:

1-(4-Methoxy-benzyl)-2,3-dihydro-1*H*-imidazo[1,2-f]phenanthridinium bromide;

1-(2-Hydroxy-ethyl)-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

2,3-Dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-Isopropyl-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-Cyclopropyl-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-(4-Methoxy-phenyl)-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-Phenyl-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-paramethoxyaniline-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-Methoxycarbonylmethyl-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-(1-Methoxycarbonyl-2-phenyl-ethyl)-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-Benzyl-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-(2-Mercapto-ethyl)-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

3-(4-Methoxy-benzyl)-2,3-dihydro-1H-imidazo[1,2-a]quinolin-10-ylium bromide;

1-(4-Methoxy-benzyl)-2,3-dihydro-1H-imidazo[2,1-a]isoquinolin-4-ylium bromide;

1-(4-Methoxy-benzyl)-2,3-dihydro-1H-imidazo[1,2-a]pyridin-4-ylium bromide; 1-Propyl-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-(2-Hydroxy-1-methyl-ethyl)-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-[1-(4-Methoxy-phenyl)-ethyl]-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

~~7-Bromo-1-(4-methoxy-benzyl)-2,3-dihydro-1H-~~imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-(4-Ethyl-phenyl)-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-Hexyl-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

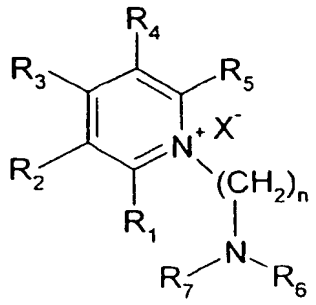
1-Dodecyl-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-Octadecyl-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide;

1-(3,3-Diphenyl-propyl)-2,3-dihydro-1H-imidazo[1,2-f]phenanthridin-4-ylium bromide; or

1-(4-Methoxy-benzyl)-2,3-dihydro-1H-imidazo[1,2-c]quinazolin-4-ylium bromide.

7. A compound represented by Formula B:



wherein:

n is 2 to 5;

R_1 is hydrogen;

independently R_2 and R_3 and/or R_4 and R_5 together can form an aromatic carbon or heterocyclic ring structure, optionally substituted with one or more aromatic substituents, or R_2, R_3, R_4 and R_5 are independently selected from an aromatic substituent;

R_6 and R_7 are independently a substituent or a linking group to form a multimeric compound in which a plurality of compounds represented by Formula A as set out in any one of claims 1 to 7 and/or Formula B are covalently bonded together;

X^- is an anionic moiety;

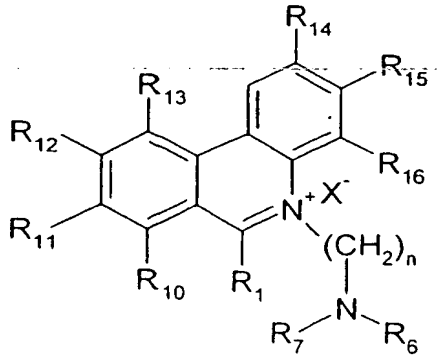
and wherein:

the substituent or substituents are independently selected from halo, hydroxy, oxo, ether, formyl, C_{1-7}alkylacyl, C_{5-20}arylacyl, acylhalide, carboxy, ester, acyloxy, amido, acylamido, thioamido, tetrazolyl, amino, nitro, nitroso, azido, cyano, isocyano, cyanato, isocyanato, thiocyano,

isothiocyano, sulfhydryl, thioether, sulfonic acid, sulfonate, sulfone, sulfonyloxy, sulfinyloxy, sulfamino, sulfonamino, sulfinamino, sulfamyl, sulfonamido, C_{1-7}alkyl, C_{1-7}haloalkyl, C_{1-7}hydroxyalkyl, C_{1-7}carboxyalkyl, C_{1-7}aminoalkyl, C_{5-20}aryl-C_{1-7}alkyl, C_{3-20}heterocyclyl, or C_{5-20}aryl; and

the aromatic substituent or substituents are independently selected from hydrogen, -F, -Cl, -Br, -I, -OH, -OMe, -OEt, -SH, -SMe, -SEt, -C(=O)Me, -C(=O)OH, -C(=O)OMe, $-CONH_2$, -CONHMe, $-NH_2$, $-NMe_2$, $-NEt_2$, $-N(nPr)_2$, $-N(iPr)_2$, -CN, $-NO_2$, -Me, -Et, $-CF_3$, $-OCF_3$, $-CH_2OH$, $-CH_2CH_2OH$, $-CH_2NH_2$, $-CH_2CH_2NH_2$, -Ph, ether, ester, amido, amino, C_{1-7}alkyl, C_{1-7}haloalkyl, C_{1-7}hydroxyalkyl, C_{1-7}carboxyalkyl, C_{1-7}aminoalkyl, or C_{5-20}aryl-C_{1-7}alkyl.

8. The compound according to claim 7 which is represented by Formula Bi:



wherein:

n is 2 to 5;

R_1 is hydrogen;

R_6 and R_7 are independently hydrogen, a substituent or a linking group to form a multimeric compound in which a

plurality of compounds represented by Formula A and/or Formula B are covalently bonded together;

R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, R_{15} and R_{16} are independently selected from hydrogen or an aromatic substituent; and

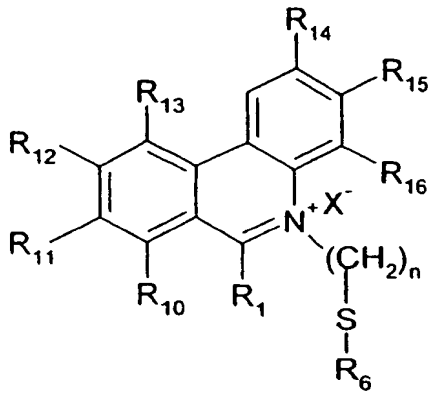
X^- is an anionic moiety

and wherein:

the substituent or substituents are independently selected from halo, hydroxy, oxo, ether, formyl, C_{1-7}alkylacyl, C_{5-20}arylacyl, acylhalide, carboxy, ester, acyloxy, amido, acylamido, thioamido, tetrazolyl, amino, nitro, nitroso, azido, cyano, isocyano, cyanato, isocyanato, thiocyano, isothiocyano, sulfhydryl, thioether, sulfonic acid, sulfonate, sulfone, sulfonyloxy, sulfinyloxy, sulfamino, sulfonamino, sulfinamino, sulfamyl, sulfonamido, C_{1-7}alkyl, C_{1-7}haloalkyl, C_{1-7}hydroxyalkyl, C_{1-7}carboxyalkyl, C_{1-7}aminoalkyl, C_{5-20}aryl-C_{1-7}alkyl, C_{3-20}heterocyclyl, or C_{5-20}aryl; and

the aromatic substituent or substituents are independently selected from hydrogen, -F, -Cl, -Br, -I, -OH, -OMe, -OEt, -SH, -SMe, -SEt, -C(=O)Me, -C(=O)OH, -C(=O)OMe, $-CONH_2$, -CONHMe, $-NH_2$, $-NMe_2$, $-NEt_2$, $-N(nPr)_2$, $-N(iPr)_2$, -CN, $-NO_2$, -Me, -Et, $-CF_3$, $-OCF_3$, $-CH_2OH$, $-CH_2CH_2OH$, $-CH_2NH_2$, $-CH_2CH_2NH_2$, -Ph, ether, ester, amido, amino, C_{1-7}alkyl, C_{1-7}haloalkyl, C_{1-7}hydroxyalkyl, C_{1-7}carboxyalkyl, C_{1-7}aminoalkyl, or C_{5-20}aryl-C_{1-7}alkyl.

9. A compound which is represented by the Formula Bii:



wherein:

n is 2 to 5;

R_1 is hydrogen;

R_6 is hydrogen, a substituent; or a linking group to form a multimeric compound in which a plurality of compounds represented by Formula A and/or Formula B are covalently bonded together;

R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, R_{15} and R_{16} are independently selected from hydrogen or an aromatic substituent; and

X^- is an anionic moiety

and wherein:

the substituent or substituents are independently selected from halo, hydroxy, oxo, ether, formyl, C_{1-7}alkylacyl, C_{5-20}arylacyl, acylhalide, carboxy, ester, acyloxy, amido, acylamido, thioamido, tetrazolyl, amino, nitro, nitroso, azido, cyano, isocyano, cyanato, isocyanato, thiocyano, isothiocyano, sulfhydryl, thioether, sulfonic acid, sulfonate, sulfone, sulfonyloxy, sulfinyloxy, sulfamino, sulfonamino, sulfinamino, sulfamyl, sulfonamido, C_{1-7}alkyl,

C_{1-7}haloalkyl, C_{1-7}hydroxyalkyl, C_{1-7}carboxyalkyl, C_{1-7}aminoalkyl, C_{5-20}aryl-C_{1-7}alkyl, C_{3-20}heterocyclyl, or C_{5-20}aryl; and

the aromatic substituent or substituents are independently selected from hydrogen, -F, -Cl, -Br, -I, -OH, -OMe, -OEt, -SH, -SMe, -SEt, -C(=O)Me, -C(=O)OH, -C(=O)OMe, $-CONH_2$, -CONHMe, $-NH_2$, $-NMe_2$, $-NEt_2$, $-N(nPr)_2$, $-N(iPr)_2$, -CN, $-NO_2$, -Me, -Et, $-CF_3$, $-OCF_3$, $-CH_2OH$, $-CH_2CH_2OH$, $-CH_2NH_2$, $-CH_2CH_2NH_2$, -Ph, ether, ester, amido, amino, C_{1-7}alkyl, C_{1-7}haloalkyl, C_{1-7}hydroxyalkyl, C_{1-7}carboxyalkyl, C_{1-7}aminoalkyl, or C_{5-20}aryl-C_{1-7}alkyl.

10. The compound according to any one of claims 7 to 9, wherein n is 2 or 3.

11. The compound according to any one of claims 7 to 10, which is::

5-(2-tert-butylamino-ethyl)-phenanthridinium bromide;

5-(2-Piperidin-1-yl-ethyl)-phenanthridinium bromide;

piperazine phenanthridinium derivatives;

hydroxylamine derivatives;

1,5,9triaza-Cyclododecane;

5-[2-(4-methoxy-benzylsulfanyl)-ethyl]-phenanthridinium bromide.

12. The compound according to any one of the preceding claims, wherein X^- the anionic moiety is selected from halogen, tosylate or mesylate.

13. The compound according to any one of the preceding claims, wherein when the R_2 and R_3 and/or R_4 and R_5 substituents are present, one or both of these pairs of substituents together form an aromatic carbon or

heterocyclic ring structure, optionally substituted with one or more aromatic substituents.

14. The compound according to any one of the preceding claims, wherein the compounds forming the multimeric compound are covalently bonded together via their respective R_1 substituents (Formula A) or via their R_6 or R_7 substituents (Formula B) or via a spacer group.

15. A multimeric compound formed by covalently linking two or more of the same or different compounds according to any one of the preceding claims

16. The multimeric compound according to claim 15, wherein compounds of Formula A are linked via the R_1 substituent and/or compounds represented by Formula B are linked via the R_6 and/or R_7 substituents.

17. The multimeric compound according to claim 15 or ~~claim~~ 16, ~~wherein, where~~ the compounds of Formula B are linked via the R_6 and R_7 substituents, the resulting linkage forms a cycloalkyl group.

18. The multimeric compound according to any one of claims 15 to 17, wherein the compounds are covalently bonded via a linker group or linker groups.

19. The multimeric compound according to claim 18, wherein the linker groups is a C_{1-7} alk-di-yl group bonded to another group of Formula A or B in place of R_1 thereof; a piperazin-di-yl group bonded to another group of Formula A or B in place of R_1 thereof; a (N,N-C_{1-6} dialkylene) C_{1-7} alkylene amine bonded to two other groups of Formula A or B in place of R_1 thereof; or a cyclo (C_{4-8}) alk-tri-yl

group bonded to two other groups of Formula A or B in place of R_3 thereof.

20. The multimeric compound according to any one of claims 15 to 17, wherein the multimeric compound is a dimer, trimer or tetramer of the compounds according to any one of claims 1 to 14.

21. The multimeric compound according to any one of claims ~~13~~ 15 to ~~18~~ 20, wherein the compounds of Formula A and/or B are covalently bonded to a spacer group.

22. The multimeric compound according to claim ~~19~~ 21 in which 2 or more, 3 or more, 4 or more, 5 or more, 10 or more, 20 or more, 50 or more, or 100 or more compounds represented by Formula A or B are covalently linked via one or more spacer groups.

23. The multimeric compound according to claim ~~19~~ 21 or claim ~~20~~ 22, wherein the spacer group is a polyamine compound comprising an alkyl chain having a plurality of amine groups for reacting with the compounds of Formula A an/or B.

24. The multimeric compound according to any one of claim 15 to ~~21~~ 23, wherein the compound is a selected from:

Dimers:

Ethylene diamine derivative with two groups of Formula A.

Hydroxylamine derivative with two groups of Formula B.

Piperazine derivative with two groups of Formula B.

DIP dimer derived from the spacer N1-(2-Amino-ethyl)-ethane-1,2-diamine

DIP dimer derived from the spacer 2-Amino-1-[4-(2-amino-acetyl)-piperazin-1-yl]-ethanone

DIP dimer derived from the spacer 2-[4-(2-Amino-ethyl)-piperazin-1-yl]-ethylamine

Phenanthridinium dimer derived from the spacer 2-[4-(2-Amino-ethyl)-piperazin-1-yl]-ethylamine

Trimers:

Tris (2-aminoethylamine) derivatives with three groups of Formula A

Cis-triaminocyclohexane derivatives with three groups of Formula A.

2-Amino-1-[5,9-bis-(2-amino-acetyl)-1,5,9triaza-cyclododec-1-yl]-ethanone derivative with three groups of Formula A.

2-[5,9-Bis-(2-amino-ethyl)-1,5,9triaza-cyclododec-1-yl]-ethylamine derivative with three groups of Formula A.

1,5,9-triaza-cyclododecane derivative with three groups of Formula B.

DIP trimer derived from the spacer 2-Amino-1-[5,9-bis-(2-amino-acetyl)-1,5,9triaza-cyclododec-1-yl]-ethanone

DIP trimer derived from the spacer Cyclohexane-1,3,5-triamine

Phenanthridinium trimer derived from the spacer 2-[5,9-Bis-(2-amino-ethyl)-1,5,9triaza-cyclododec-1-yl]-ethylamine

Tetramers:

Tetrakis-(6-amino-hexyl)-ammonium bromide derivative with four groups of Formula A.

25. A composition comprising one or more compounds according to any one of the preceding claims.

26. A compound according to any one of claims 1 to ~~22~~ 24 for use in a method of therapy or diagnosis.

27. Use of a compound according to any one of claims 1 to ~~22~~ 24 as a DNA cross-linking agent, a DNA binding agent, a telomere binding agent, a biological probe or a diagnostic probe.

28. Use of a compound according to any one of claims 1 to ~~22~~ 24 for the preparation of a medicament for the treatment of a condition treatable by an anti-cancer agent, an anti-inflammatory agent, or an antiprotozoal agent. ~~or a topoisomerase inhibitor~~

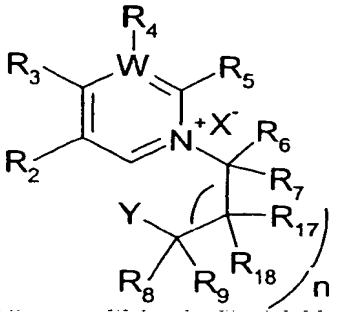
29. The use according to claim ~~26~~ 28, wherein the medicament is for the treatment of cancer.

30. Use of a compound according to any one of claims 1 to ~~22~~ 24 as a synthetic agent, a reducing agent, a chiral

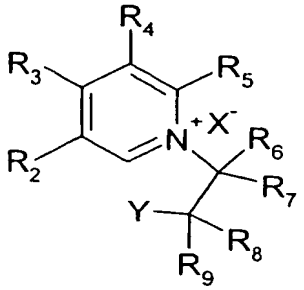
reducing reagent, an amine protecting group, a phase transfer catalyst, or a chiral resolving agent for purification or crystallisation.

31. Use of a compound according to any one of claims 1 to 24 as an electronic material, a photochemically active agent or sensor or as molecular switching device.

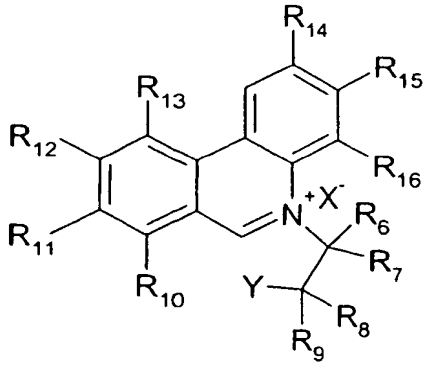
32. A method of synthesising a heterocyclic aromatic cationic compound with an additional ring, the method comprising reacting a heterocyclic aromatic cationic compound comprising a ring nitrogen and at least one alpha hydrogen atom according to formula A', Ai' or Aii'



A'



Ai'



Aii'

with a substituted or unsubstituted primary amine, a sulphide ~~sulphate~~ or a hydroxide, wherein the primary amine, sulphide ~~sulphate~~ or hydroxide reacts with the heterocylic aromatic compound by alpha addition, cyclisation and an

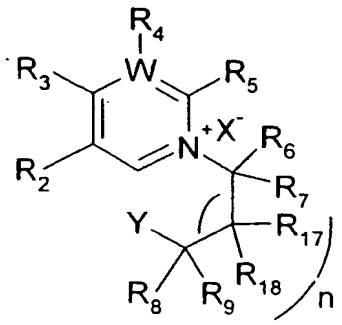
oxidation step thereby providing the heterocyclic aromatic compound with an additional ring.

33. The method according to claim ~~30~~ 32, wherein the additional ring is a five membered ring.

34. The method according to claim ~~30~~ 32 or claim ~~31~~ 33, wherein the reaction is a one pot reaction.

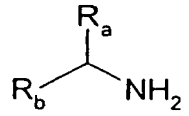
35. The method according to any one of claims ~~30~~ 32 to ~~32~~ 34, wherein the method is for making a compound represented by Formula A as defined in claim 1 and comprises:

reacting a heterocyclic aromatic compound represented by the Formula A':



wherein Y is a leaving group and n and the remaining substituents are as defined in claim 1;

with a primary amine represented by the formula:

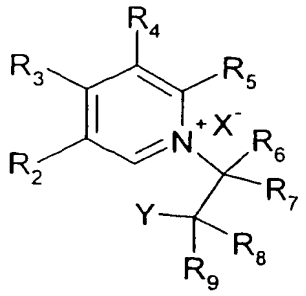


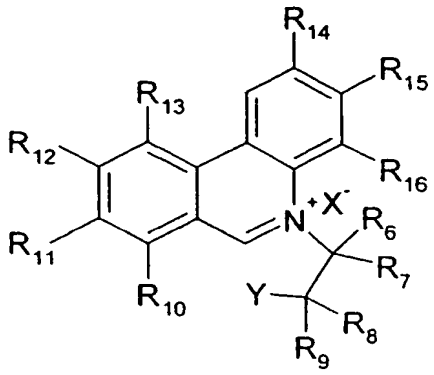
wherein the R_a-C-R_b substituents of the primary amine forms the group R_1 in the final compound;

the primary amine reacting with the phenanthridinium compounds of Formula A' by addition, cyclisation and oxidation to produce a compound represented by Formula A.

36. The method according to any one of claims ~~30~~ 32 to ~~33~~ 35, wherein the method is for making a compound represented by Formula Ai or Aii as defined in claim 2 or claim 3 and comprises:

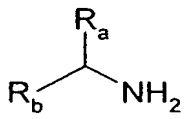
reacting a heterocyclic aromatic compound represented by the Formula Ai' or Aii' respectively:





wherein Y is a leaving group and the remaining substituents are as defined in claim 2 or claim 3;

with a primary amine represented by the formula:



wherein the R_a-C-R_b substituents of the primary amine forms the group R_1 in the final compound;

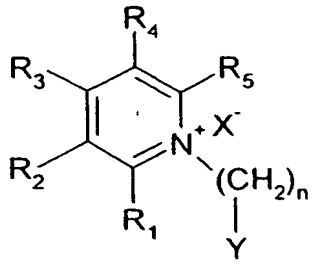
the primary amine reacting with the phenanthridinium compounds of Formula Ai' by addition, cyclisation and oxidation to produce a compound represented by Formula Ai.

37. The method according to any one of claims ~~30~~ 32 to ~~34~~ 36, wherein the method uses a primary amine which (1) has no substituents in the alpha position, or (2) has a primary carbon in the alpha position, or (3) has a secondary carbon in the alpha position), or (4) has a tertiary carbon in the alpha position, or (5) is or derives from an amino acid.

38. The method according to any one of claims ~~30~~ 32 to ~~34~~ 36, wherein the primary amine is an aromatic amines, such as naphthalen-1-ylamine or anthracen-9-ylamine.

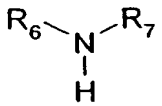
39. A method of making compounds represented by Formula B as defined in claim 7, the method comprising:

reacting a heterocyclic aromatic compound represented by the Formula B':



wherein Y is a leaving group and the remaining substituents are as defined in claim 7;

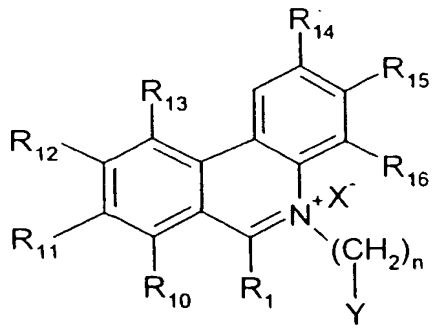
with a secondary amine represented by the Formula:



the secondary amine reacting with the compound of Formula B' to produce a compound represented by Formula B.

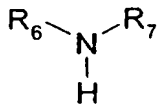
40. The method according to claim 39 for making compounds represented by Formula Bi as defined in claim 8, the method comprising:

reacting a heterocyclic aromatic compound represented by the Formula Bi':



wherein Y is a leaving group and the remaining substituents are as defined in claim 8;

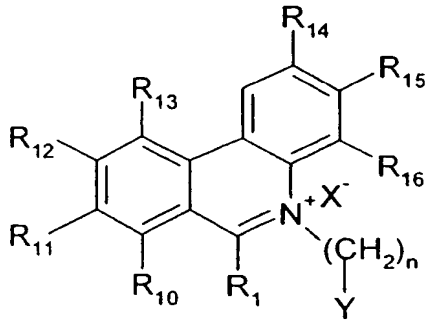
with a secondary amine represented by the formula:



the secondary amine reacting with the compound of Formula Bi' by to produce a compound represented by Formula Bi.

41. A method of making compounds represented by Formula Bii as defined in claim 9, the method comprising:

reacting a heterocyclic aromatic compound represented by the Formula Bii':



with a sulphur containing compound such as substituted or unsubstituted thiol to produce a compound represented by Formula Bii.

42. The method according to any one of claims ~~30~~ 32 to ~~39~~ 41, further comprising the step of forming a multimeric compound according to any one of claim 15 to ~~22~~ 24.